421762

FLOOD INSURANCE STUDY

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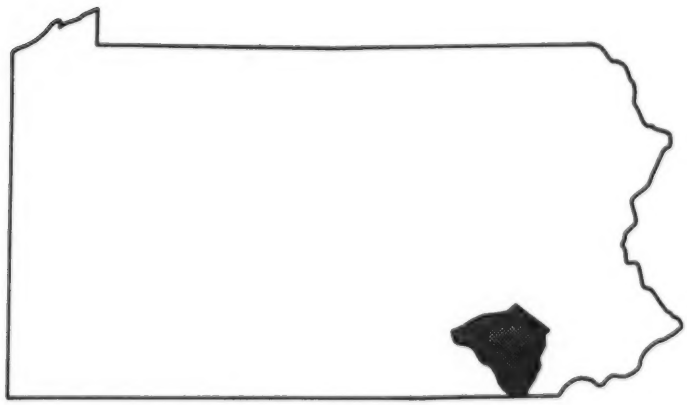
TOWNSHIP OF BRECKNOCK, PENNSYLVANIA
LANCASTER COUNTY



OCTOBER 1, 1980

FEDERAL EMERGENCY MANAGEMENT AGENCY
FEDERAL INSURANCE ADMINISTRATION
COMMUNITY NUMBER - 421762

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index

Flood Insurance Rate Map

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Brecknock, Lancaster County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Brecknock to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses used for this study were prepared by Huth Engineers, Inc., for the Federal Insurance Administration, under Contract No. H-4760. This work was completed in September 1979.

1.3 Coordination

In April 1978, the nature and purpose of the Flood Insurance Study were explained and the streams studied by detailed methods identified at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of the FIA, the Township of Brecknock, and the study contractor. A notice announcing the beginning of the study and stating its objectives was placed in the Lancaster New Era newspaper.

During the course of the study, contact was made with the Soil Conservation Service, the U. S. Army Corps of Engineers (COE), the U. S. Geological Survey (USGS), the Pennsylvania Department of Environmental Resources, the Susquehanna River Basin Commission, and the Lancaster County Planning Commission for information concerning flood problems in the township. Also, a letter was sent to community officials requesting pertinent information. On March 27, 1980, a final CCO meeting was held with representatives of the FIA, the township, and the study contractor to present the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Brecknock, Lancaster County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

Tributary 2 from a point approximately 50 feet downstream of the Beam Road bridge to Fivepointville Road was studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through September 1984.

Tributary 2 from the confluence with Muddy Creek to the limit of detailed study was studied by approximate methods. Also, Muddy Creek, Little Muddy Creek, Black Creek, Tributary 1, and Tributaries 3 through 7 were studied by approximate methods. Approximate methods of analysis were used to study those areas having low development potential and minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by the FIA.

2.2 Community Description

The Township of Brecknock is located in northeastern Lancaster County in southeastern Pennsylvania. It is bordered by the Townships of Brecknock (Berks County) and Caernarvon (Berks County) to the east, the Borough of Adamstown to the north, the Township of East Cocalico to the west, and the Townships of Earl, East Earl, and Caernarvon (Lancaster County) to the south.

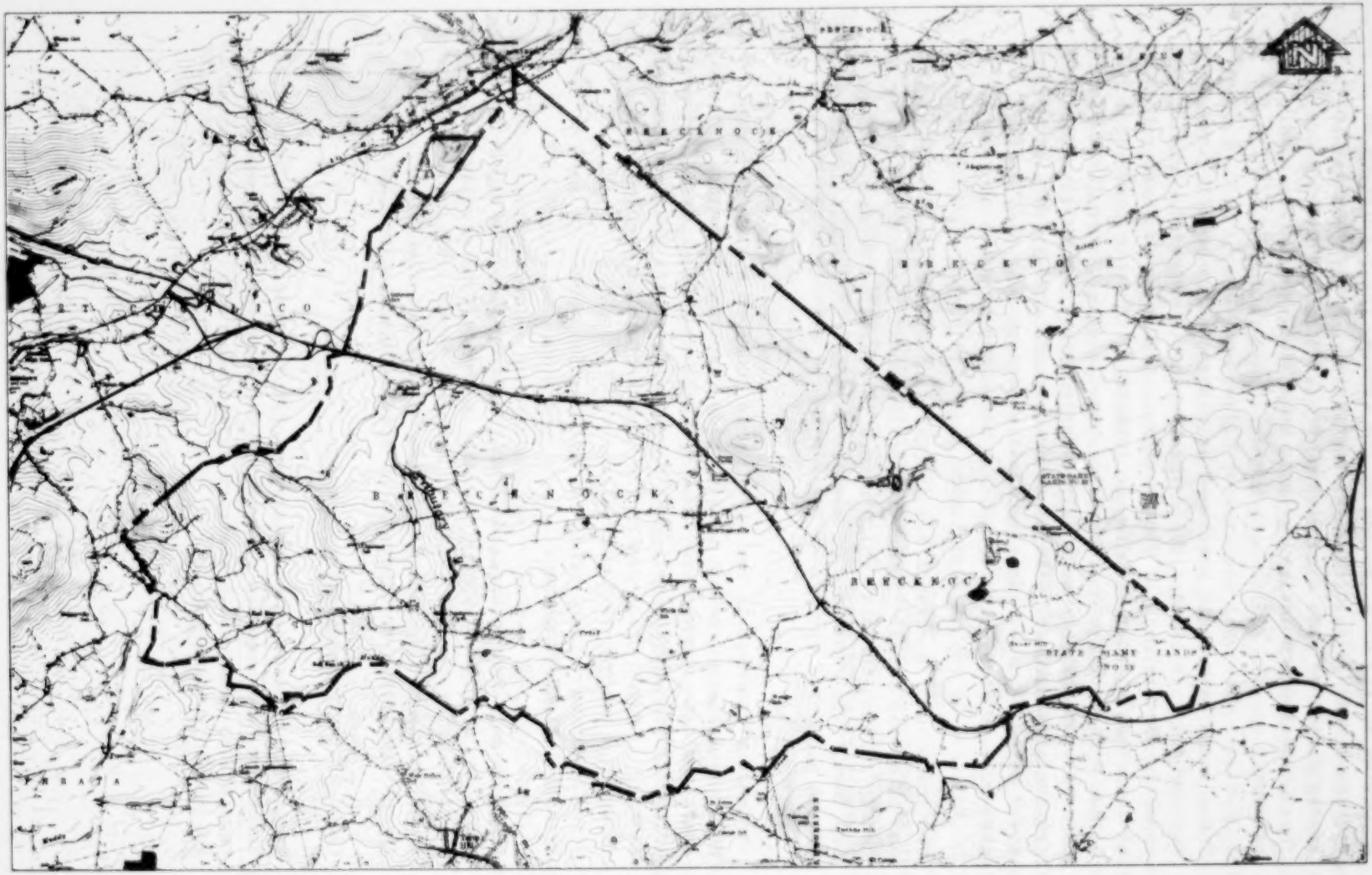


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF BRECKNOCK, PA
(LANCASTER CO.)

APPROXIMATE SCALE

6000 0 6000 12000 18000 FEET

VICINITY MAP

According to the U. S. Bureau of the Census, the population of Brecknock was 3,478 in 1970 (Reference 1). The Commonwealth of Pennsylvania projects a population of 3,772 by 1980 (Reference 2). This projected population reflects an annual growth rate of 0.8 percent.

The general climate of Brecknock is classified as modified humid continental. Precipitation in the township averages 41 inches annually (Reference 3). Thunderstorms, the major cause of precipitation, mostly occur from May to September. These storms are localized in character and are usually associated with localized flooding. Major floods that are regional occurrences are the result of large tropical disturbances like hurricanes or combined events, as when heavy rains occur during a snowmelt. Average snowfall for the region is 30 inches, which usually melts during March and April.

The Township of Brecknock has a total land area of 24.9 square miles and is mostly rural. Productive agricultural land is located on gently rolling terrain, which ranges in elevation between 350 and 920 feet. The community of Bowmansville is the largest development in the township.

Stormwater drainage in the township is conveyed by Little Muddy, Muddy, and Black Creeks. Little Muddy Creek and Tributary 2 flow south and form the western township boundary. Black Creek, also a tributary of Muddy Creek, flows west and forms the southern township boundary. Muddy Creek drains the central part of Brecknock and flows in a southwestern direction.

2.3 Principal Flood Problems

Historic data and information resulting from this study show that Tributary 2 south of Fivepointville is the major source of flood problems in Brecknock. In 1972, Tropical Storm Agnes caused a major flood in the Muddy Creek Basin. An estimate of the flood frequency is not available, as there are no stream gage stations locally.

2.4 Flood Protection Measures

At present, there are no structural flood protection measures within Brecknock, and none are planned for the near future. Flood plain regulations exist which restrict development in flood-prone areas in the township (Reference 4).

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail affecting the community.

The discharge volumes for Tributary 2 were developed using USGS regionalized models for natural streams (Reference 5). Model 6B was used to develop the streamflow volumes. The 500-year flood frequency was developed through the extension of flood-frequency relationships for the 10-, 50-, and 100-year floods.

A summary of drainage area-peak discharge relationships for Tributary 2 is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 2					
At confluence with Muddy Creek	2.6	330	580	710	1,050

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding source studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along this flooding source.

Cross-section data for streams in the area were obtained from aerial photographs (Reference 6); the below-water sections were obtained by field measurement. All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Roughness coefficients (Manning's "n" values) for Tributary 2 were estimated by field inspection and based on engineering judgment. The channel roughness value was 0.030, and the overbank values ranged between 0.035 and 0.070.

Water-surface profiles were determined using the COE HEC-2 step-backwater computer model (Reference 7). Starting water-surface elevations for Tributary 2 were calculated using the slope/area method.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 3).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 5 feet (Reference 6). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

For the streams studied by approximate methods, the 100-year flood boundaries were determined using the Flood Hazard Boundary Map for the Township of Brecknock (Reference 8).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this report is presented to local agencies as a minimum standard that can be adopted or that can be used as a basis for additional studies.

The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for the flooding source affecting the Township of Brecknock.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Tributary 2								
A	600	100	582	1.4	372.9	372.9	373.4	0.5
B	691	40	243	3.2	373.0	373.0	373.4	0.4
C	1,466	29	76	9.3	374.3	374.3	374.3	0.0
D	2,441	40	134	5.4	381.0	381.0	381.3	0.3
E	3,131	79	115	7.3	386.2	386.2	386.2	0.0
F	3,631	103	181	3.9	389.9	389.9	389.9	0.0

[1] Feet above corporate limits

TABLE 2

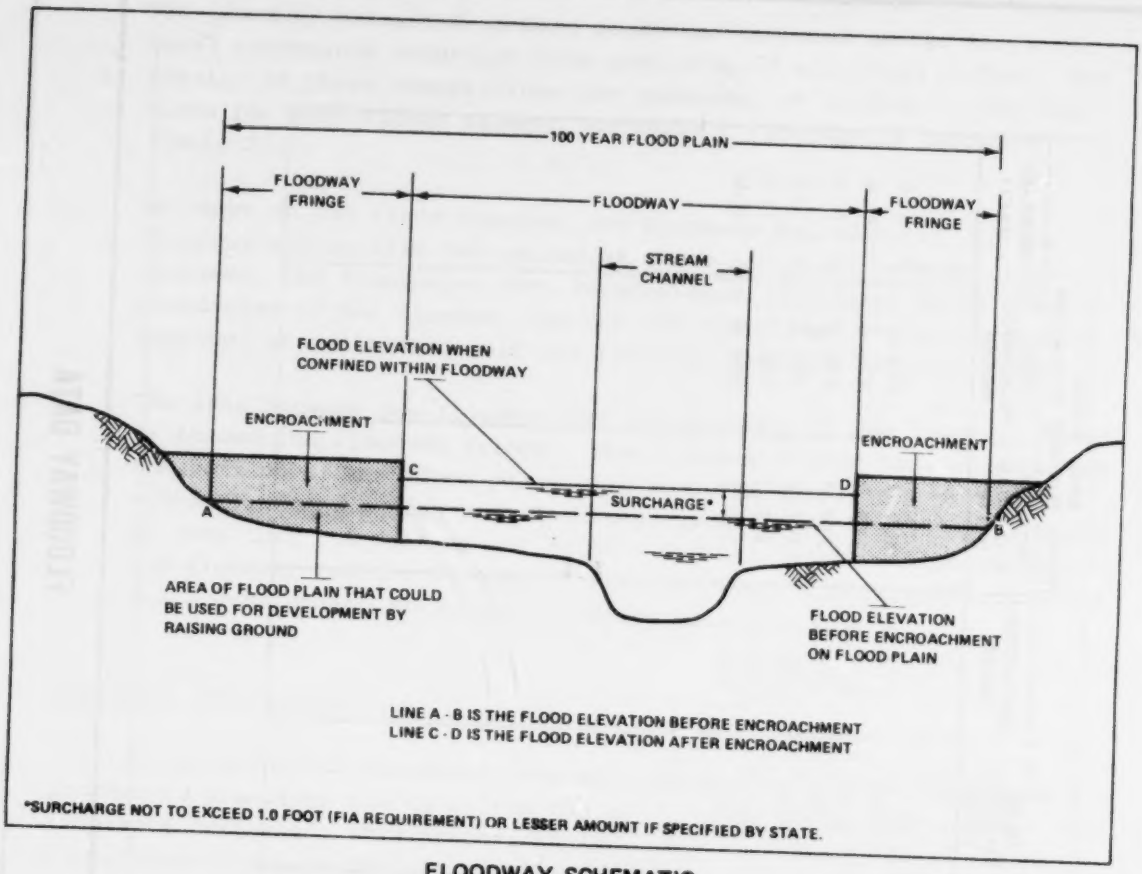
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF BRECKNOCK, PA

(LANCASTER CO.)

FLOODWAY DATA

TRIBUTARY 2


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
A
B
SURCHARGE*
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC

Figure 2

The locations of the reaches determined for the flooding source of the Township of Brecknock are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Tributary 2							
Reach 1	05	-3.3	-1.0	+1.9	035	A7	Varies
Reach 2	05	-1.0	-0.3	+0.6	010	A2	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF BRECKNOCK, PA
[LANCASTER CO.]

FLOOD INSURANCE ZONE DATA

TRIBUTARY 2

the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Township of Brecknock was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A2, A7:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the township.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Brecknock is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

Flood Insurance Studies for the Townships of East Cocalico, Earl, Caernarvon (Lancaster County), and Brecknock (Berks County) and the Borough of Adamstown are currently being prepared (Reference 9, 10, 11, 12, and 13). The results of those studies will be in exact agreement with the results of this study. Also, the Flood Hazard Boundary Map for the Township of Brecknock has been published (Reference 8).

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this report can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

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12. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Brecknock, Berks County, Pennsylvania (Unpublished).

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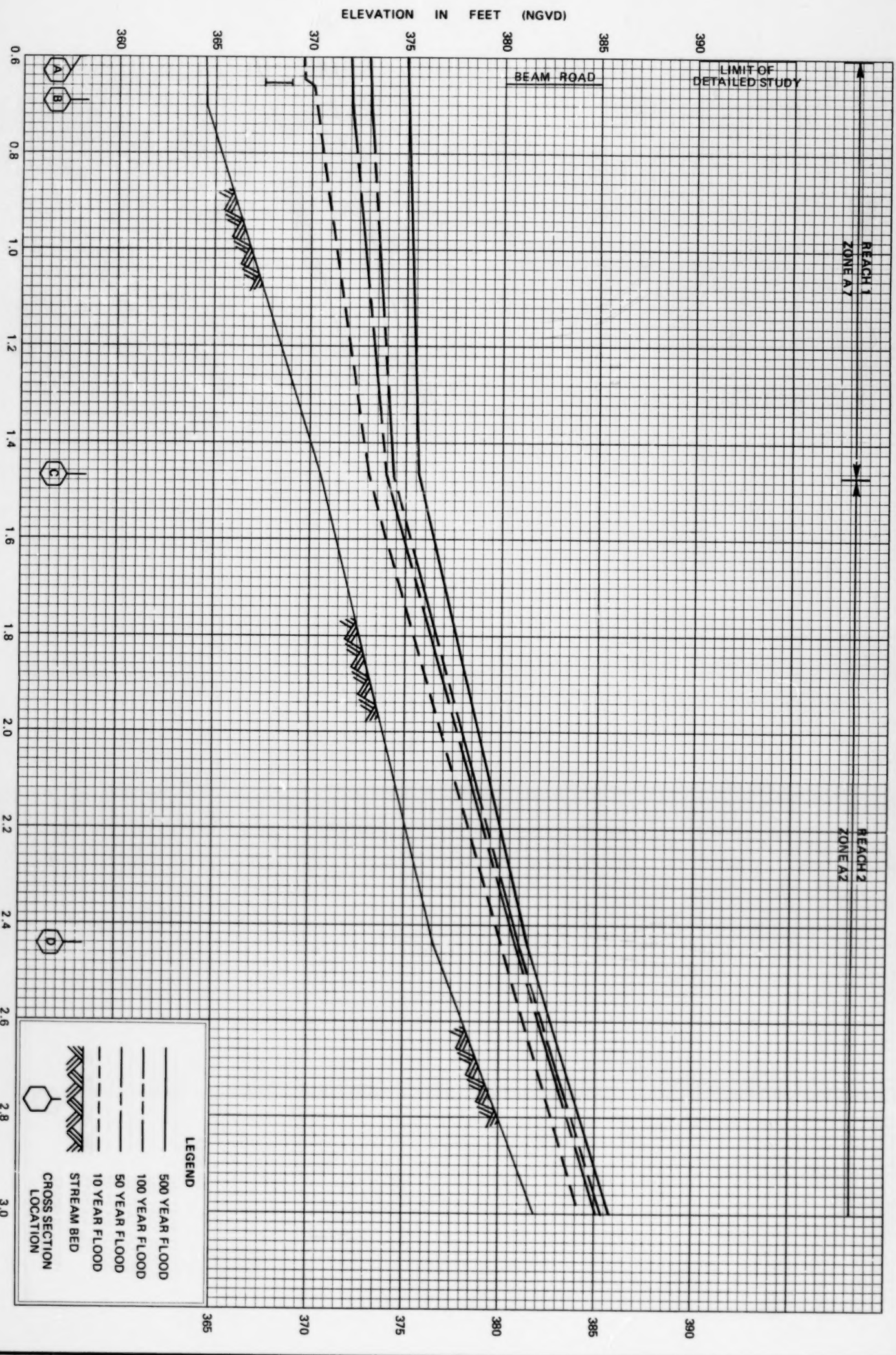


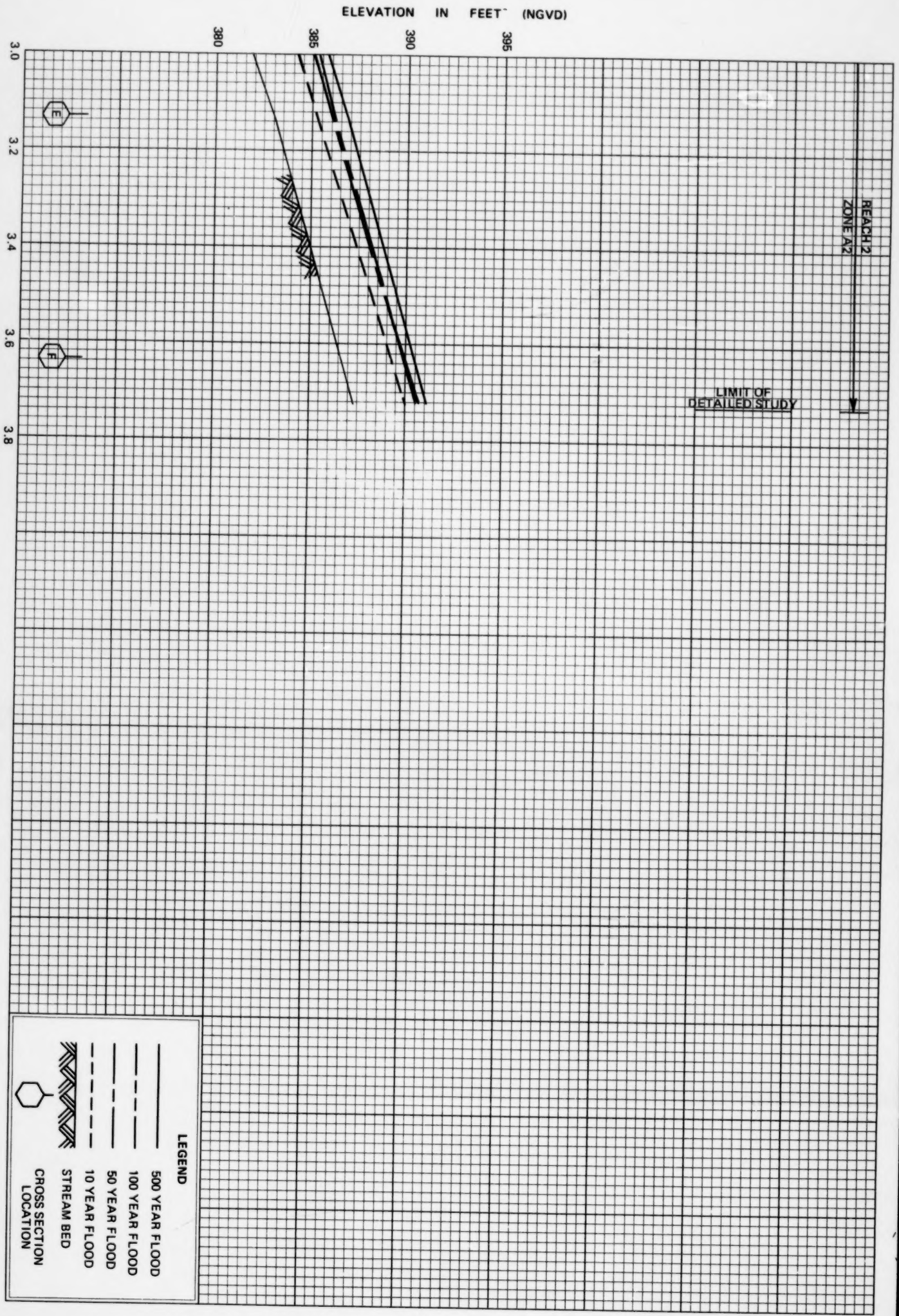
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF BRECKNOCK, PA
(LANCASTER CO.)

FLOOD PROFILES

TRIBUTARY 2

01P



STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CORPORATE LIMITS

best copy available

02P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF BRECKNOCK, PA
(LANCASTER CO.)

FLOOD PROFILES

TRIBUTARY 2